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PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Improvements in and relating to Tube Vibrators

I, KNUT VILHELM LINDKVIST, of Drottninggatan 34, Stockholm, Sweden, of Swedish Nationalitiy, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a tubular vibrator for the generation of high frequency vibrations—higher than 100 cycles per second (i.e., 6000 vibrations/minute) at which frequency a good output of work is obtained—for the compression of plastic materials (particularly concrete), of the kind comprising a cylindrical casing enclosing at least one eccentrically-loaded impulse member disposed for rotation in the casing.

The object of the invention is to provide a tubular vibrator of improved construction in which the casing, when it becomes worn due to the abrasive action of the material in which it is used, can be discarded, and the impulse members with their associated bearings in suitable lining sleeves can be conveniently and accurately repositioned within a similar unworn casing.

A further object is to ensure the adequate lubrication of the bearings.

According to the invention, the cylindrical casing is provided with a removable lining sleeve which has the eccentrically-loaded impulse member or members disposed for rotation therein, and with a plug closing the end of the casing and securing the adjacent end of the lining sleeve in proper lengthwise position therein, the plug carrying an oil cup for supplying oil to passages communicating with bearings at the inner surface of the lining sleeve for the rotating impulse members.

According to a further feature the or each impulse member consists of a cylindrical rotor with two plain bearing surfaces running against a plain bearing on the lining sleeve, the rotor having a number of preferably symmetrically-arranged bores parallel with the rotor shaft, the bores in one half of the cross-section being filled with heavy metal and the other bores being for oil in order to obtain in a simple manner a rotor of small diameter but out of balance, and the oil-carrying bores communicating, through radial holes, with the said bearing surfaces for supplying the oil for lubricating them.

The invention may be further characterized in that above and below the rotor there is provided a perforated oil-catching cover to catch oil passing through the space between the rotor shaft and the holes of the cover and to retain it until the pressure, increased by centrifugal force, conveys it through the radial holes to the plain bearing surfaces.

According to a still further feature the rotor is elongated in the downward direction by means of a pin inserted in a double-acting axial thrust bearing obtaining oil through a hole in the pin guiding two bearing washers which are arranged with suitable play relatively to the bearing by means of a distance sleeve provided with lubricating grooves, in order that the bearing which absorbs forces in the direction of the rotor shaft, shall be easy to mount and be well lubricated.

Guide sleeves having contact surfaces for carrying off heat from the plain bearing surfaces may be arranged between the lining sleeve, on the one hand, and the vibrator casing, on the other hand.

The invention is illustrated in the accompanying drawing, in which:—

Figure 1 is a side view of the tube vibrator and its drive device;

Figure 2 is a longitudinal section through one embodiment of the vibrator, in which, *inter alia*, the impulse members are journalled in a number of ball bearings;

Figure 3 is a longitudinal section

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through another embodiment, which, *inter alia*, is provided with plain bearings;

Figure 4 is a cross-section, with parts omitted, substantially on the line 4—4 of Figure 2;

Figures 5 and 6 are cross-sectional views of alternative constructions of impulse member; and

Figure 7 is a cross-section, with parts omitted, on the line 7—7 of Figure 3.

Referring to the drawings, a casing 2, Figure 1, surrounds a very fast moving, short-circuited alternating current motor (not shown) which is fed with low tension high frequency current through an electric cable 1 provided with a reinforcement 8 and with a contact plug which is built in a special manner and at the same time serves as a cover for the casing 2. The vibrator 4 communicates with the motor casing by means of an intermediate portion 3 which is relatively resistant to bending but yet elastic, said intermediate portion having for its object to prevent the transmission of the vibrations of the vibrator to the motor as well as to the adjustable handle 52 which, when required, may be applied around the intermediate portion 3. The motion of the motor is transmitted to the shaft 21 of Figure 2 (or 37 of Figure 3, as appropriate) of the vibrator by means of the flexible shaft 6, the drive pin 26 and the connecting sleeve 27. The flexible shaft is mounted in the usual manner in a coiled, tubular wear lining 28 which is pressed into a stiffening yet somewhat ductible protective tubular spring 29 which, in its turn, is protected by the preferably oil-proof intermediate portion 3 of synthetic rubber or the like. The wear lining 28 and the protective spring 29 extend through and are retained by a partially slit sleeve 30 which is screwed into the upper part of the casing 5 of the vibrator. The sleeve 30 is retained in its position by the lock nut 31 and is provided with a lubricating chamber 32 for the lubrication of the flexible shaft and its wear lining.

In the embodiment of the vibrator according to Figure 2 the impulse members of the vibrator are divided into two parts 11, 11, supported in ball bearings 12_1, 12_2, and 12_3, 12_4 respectively, which, together with bearing sleeves 13, can successively be pushed into the casing 5, fitting against each other, and held in a resiliently clamped position by means of two spring washers 10 and an end plug 9. A compression spring located above the elements and exerting a downward pressure may be used instead of the spring washers. Each part 11 of the impulse member consists of a weight arranged eccentrically in relation to the axis of rotation. Conical surfaces at the ends of the two bearing sleeves are guided and centered by an upper sleeve 14, a central distance sleeve 16 and a lower clamp bonnet 17 serving as oil holder and centering at the same time the two spring washers 10. Around the opposed ends 25 of the two eccentric weights 11 there is, furthermore, provided a connecting sleeve 24 transmitting the rotary motion from the upper to the lower eccentric weight. The lubrication of the fast moving ball bearings is effected by a propeller 19 fixed on the pin 18 of the lower eccentric weight forcing oil from the oil holder of the clamp bonnet 17 through the bearing 12_4, whereafter the oil is thrown by the centrifugal force against an ascending groove 20 of the lower bearing sleeve 13 and conveyed further upwards in the form of mist. In order to obtain a reliable lubrication all the way up to the shaft 21, an oil supply channel 23 is provided in the sleeve 14. The oil is returned through a descending spiral groove 22 in the shaft 21.

In the second embodiment of the vibrator according to Figure 3 the vibrator casing 5 is provided with an internal shoulder 33 for an outwardly cylindrical but inwardly conical guide sleeve 34 providing a guide for a long plain bearing sleeve 35 which latter, within its upper portion, is provided with a nipple 36 for guiding and centering the shaft 37.

The shaft 37 is rigidly connected with the externally cylindrical rotor 38, which acts as an eccentric weight, and provided with two plain bearing surfaces 39 running against the bearing sleeve 35. The rotor acts as an eccentric weight because one half of its cross-section is provided with a number of bores 40, Figure 6, which are parallel with the rotor shaft, or because the whole cross-section has been provided with symmetrically arranged axial bores 40, 41, Figure 5, the bores 41 in one half cross-section being filled with a heavy metal. The bores 40 communicate by means of radial holes 42 with the bearing surfaces 39, so that oil which has entered the bores 40 during operation is, by degrees, fed to the said bearing surfaces. In order to still more improve the lubrication, an oil sealing cover 43 provided with holes is arranged at each end of the rotor, these covers catching oil passing through the space between the rotor shaft and the holes of the covers and retaining it until the pressure, increased by centrifugal force, conveys it further through the bores 40 and holes 42 to th bearing surfaces 39 so that an effective lubricant circulation is obtained.

In order to absorb axial forces which may arise, the rotor 38 is elongated in the downward direction by means of a pin 47 inserted in a double-acting axial thrust bearing 44 obtaining oil from a hole 45 in the pin. Two bearing washers 46 are arranged on the pin 47 with suitable play relatively to the bearing 44 by means of distance sleeve 48 provided with lubricating grooves. It is of great importance for the efficiency and the life of this embodiment that a first rate lubricating oil with a low viscosity coefficient is used and that the heat developed in the bearings is carried off by providing a plurality of good contact surfaces. Such contact surfaces are provided at the guide sleeves 34, 49, for example. The bearing sleeve 35 is located within the vibrator casing 5 by the guide sleeves 34 and 49, the spring washers 10, a folded spring ring 50 (compensating for inaccurate measurements), an oil seal 51 and a clamp bonnet 53, when the end plug 9 is tightened.

What I claim is:—

1. A tubular vibrator, of the kind set forth, in which the cylindrical casing is provided with a removable lining sleeve which has the eccentrically - loaded impulse member or members disposed for rotation therein, and with a plug closing the end of the casing and securing the adjacent end of the lining sleeve in proper lengthwise position therein, the plug carrying an oil cup for supplying oil to passages communicating with bearings at the inner surface of the lining sleeve for the rotating impulse members.

2. A tube vibrator, according to claim 1, characterised in that the or each impulse member consists of a cylindrical rotor with two plain bearing surfaces running against a plain bearing on the lining sleeve, the rotor having a number of preferably symmetrically-arranged bores parallel with the rotor shaft, the bores in one half of the cross-section being filled with heavy metal and the other bores being for oil in order to obtain in a simple manner a rotor of small diameter but out of balance, and the oil-carrying bores communicating, through radial holes, with the said bearing surfaces for supplying the oil for lubricating them.

3. A tube vibrator, according to Claims 1 and 2, characterized in that there is a perforated oil-catching cover, at each end of the rotor, to catch oil passing through the space between the rotor shaft and the holes of the cover and to retain it until the pressure, increased by centrifugal force, conveys it through the radial holes to the plain bearing surfaces.

4. A tube vibrator, according to Claims 1 and 2, characterized in that the rotor is elongated in the downward direction by means of a pin inserted in a double-acting axial thrust bearing obtaining oil through a hole in the pin guiding two bearing washers which are arranged with suitable play relatively to the bearing by means of a distance sleeve provided with lubricating grooves, in order that the bearing which absorbs forces in the direction of the rotor shaft, shall be easy to mount and be well lubricated.

5. A tube vibrator, according to Claims 1 and 2, characterized in that guide sleeves having contact surfaces for carrying off heat from the plain bearing surfaces are arranged between the lining sleeve, on the one hand, and the vibrator casing, on the other hand.

6. A tube vibrator substantially as described with reference to Figures 1 and 2, or 1 and 3 of the accompanying drawings.

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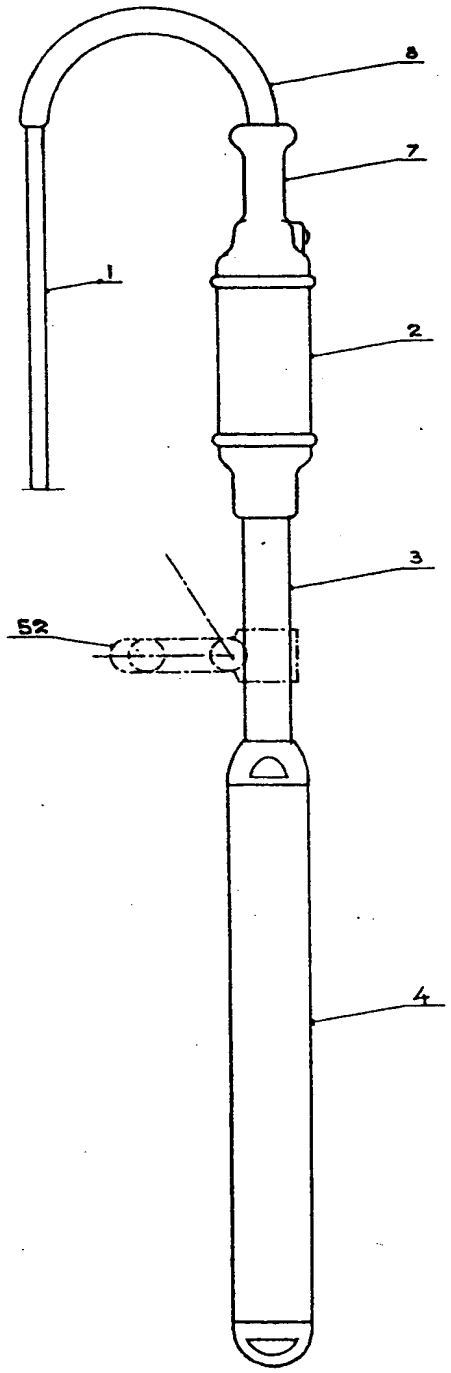
FIG. 1.



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2 SHEETS

This drawing is a reproduction of the Original on a reduced scale.

SHEETS 1 & 2

Fig.2

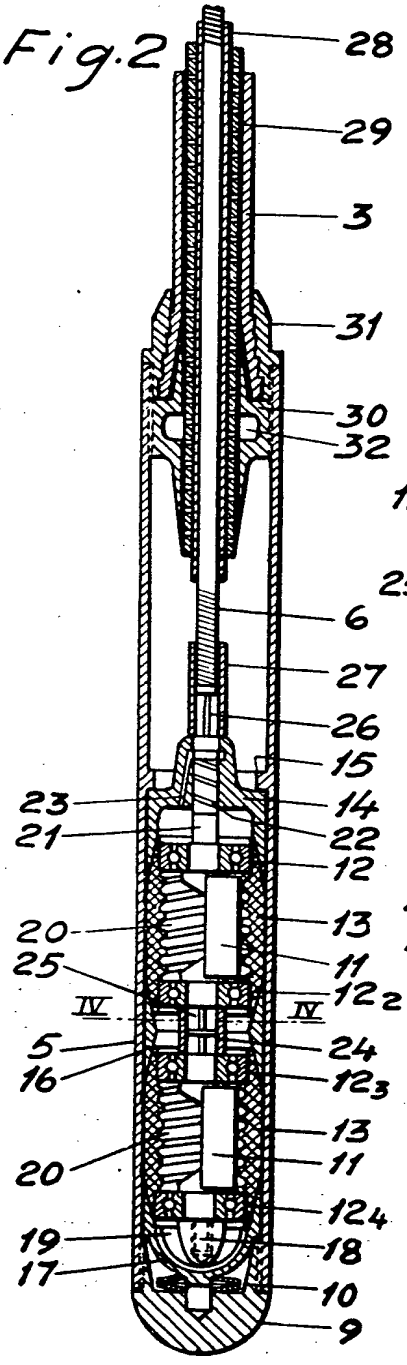

Fig.3

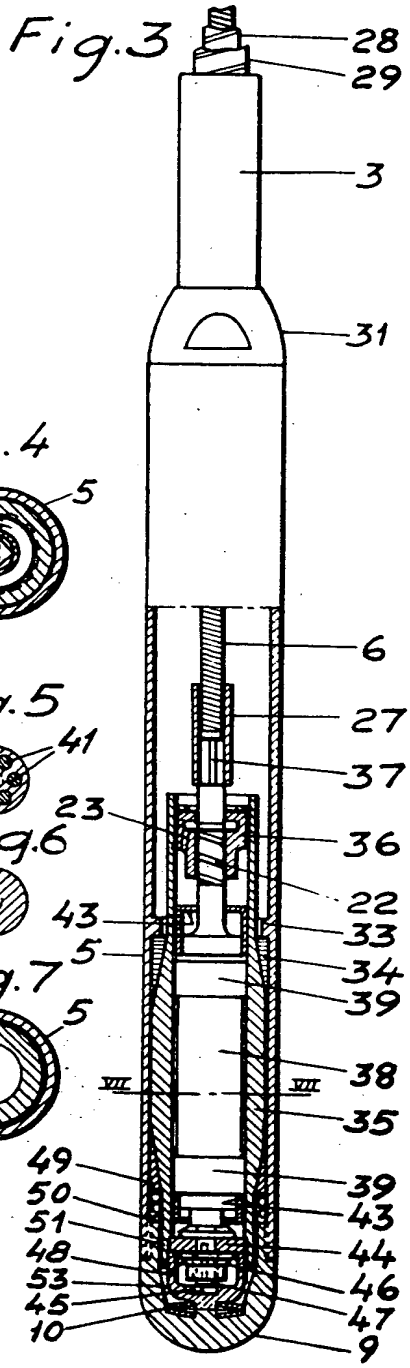

Fig.4

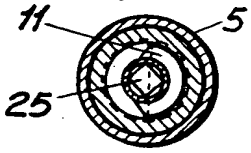

Fig.5

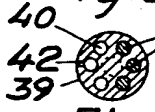

Fig.6

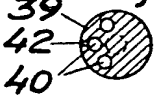

Fig.7